Abstract

The space structures such as solar array, antenna and manipulators are light weight and hence the structural flexibility of such systems are significant The dynamic modelling of these flexible systems with elastic deformations is an important aspect to be considered in design phase A large amount of literature is available on modelling, numerical simulation and control of flexible manipulators and mechanisms There is, however very little literature on analysis of flexible mechanisms which under go locking during motion During locking a mechanism loses degrees of freedom and the locking action introduces vibration in the system In this thesis the motion of a two link flexible system which locks during deployment is analysed

The finite element method is used for the flexural deformation and the equations of motion are derived by Lagrangian formulation The locking phenomenon is modelled by the momentum balance method The two link system has three phases of motion-initially the system has two rotational degrees of freedom, after the first locking one rotational degree of freedom is lost and after the second locking the system behaves like a cantilever beam An experimental set up consisting of two flexible links with revolute joint at the end of each link is designed and fabricated Each joint is having a locking mechanism which locks and prevents further rotation of joint, when the joint reaches a predefined angle

The results of numerical simulation and experiments are compared for joint rotation response and strain response during motion These were in good agreement The frequency of the system is analysed through Fast Fourier Transforms of the strain response of the mathematical model and the experimental data Thus, the momentum balance method has been demonstrated to be capable of accurately predicting the dynamics of flexible system undergo locking during motion